

WHAT IS CLAIMED IS:

- 1 1. A method of forming a magnetic tunnel junction device, comprising:
2 forming a first magnetic layer and a second magnetic layer, at least one of the first
3 and the second magnetic layers including diffusion components selected to adjust one or
4 more properties of the magnetic tunnel junction device; and
5 forming a barrier layer between the first and the second magnetic layers, the
6 barrier layer comprising migrated diffusion components from the at least one magnetic
7 layer, wherein the diffusion components adjust the one or more properties.
- 1 2. The method of claim 1, wherein the diffusion components are selected to
2 adjust a series resistance of the magnetic tunnel junction device.
- 1 3. The method of claim 1, wherein the diffusion components are selected to
2 decrease a bandgap of the barrier layer.
- 1 4. The method of claim 1, wherein:
2 forming the first magnetic layer comprises forming a pinned magnetic layer; and
3 forming the second magnetic layer comprises forming a free magnetic layer.
- 1 5. The method of claim 1, wherein one or more of the first and the second
2 magnetic layers comprises a multi-layer structure.

1 6. The method of claim 1, wherein one or more of the first and the second
2 magnetic layers comprises an alloy of CoFe.

1 7. The method of claim 6, wherein the alloy of CoFe comprises CoFeHf.

1 8. The method of claim 7, wherein the CoFeHf comprises about 5 to about
2 10 atomic percent Hf.

1 9. The method of claim 6, wherein the alloy of CoFe comprises CoFeZr.

1 10. The method of claim 9, wherein the CoFeZr comprises about 5 to about 10
2 atomic percent Zr.

1 11. The method of claim 1, wherein the diffusion components comprises Hf.

1 12. The method of claim 1, wherein the diffusion components comprises Zr.

1 13. The method of claim 1, wherein forming the first and the second magnetic
2 layers comprises forming at least one amorphous layer.

1 14. The method of claim 1, wherein forming the barrier layer comprises
2 forming a layer comprising a compound of AlO_x having a thickness of about 3 Δ to about
3 6 Δ .

1 15. The method of claim 1, wherein the forming the barrier layer comprises
2 forming a barrier layer comprising AlHfO_x .

1 16. The method of claim 1, wherein forming the barrier layer comprises
2 forming a barrier layer comprising AlZrO_x .

1 17. A method of forming a magnetic tunnel junction device, comprising:
2 forming an magnetic tunnel junction active region, comprising:
3 a first magnetic layer and a second magnetic layer, at least one of the first
4 and the second magnetic layers including diffusion components selected to adjust
5 one or more properties of the magnetic tunnel junction device; and
6 a barrier layer between the first and the second magnetic layers; and
7 annealing the active region to enhance migration of the diffusion components
8 from the first magnetic layer to the barrier layer, wherein the migrated diffusion
9 components adjust the one or more properties.

1 18. The method of claim 17, wherein the at least one layer comprises an alloy
2 of CoFe.

1 19. The method of claim 17, wherein the at least one layer comprises CoFeHf.

1 20. The method of claim 19, wherein the CoFeHf comprises about 5 to about
2 10 atomic percent Hf.

1 21. The method of claim 17, wherein the at least one layer comprises CoFeZr.

1 22. The method of claim 21, wherein the CoFeZr comprises about 5 to about
2 10 atomic percent Zr.

1 23. The method of claim 17, wherein the diffusion components comprise Hf.

1 24. The method of claim 17, wherein the diffusion components comprise Zr.

1 25. The method of claim 17, wherein the barrier layer has a thickness of about
2 3 Δ to about 6 Δ .

1 26. The method of claim 17, wherein annealing the active region comprises
2 annealing the active region at a temperature of less than about 300 C.

1 27. The method of claim 17, wherein the diffusion components are selected to
2 decrease a series resistance of the active region.

1 28. The method of claim 17, wherein annealing the diffusion components are
2 selected to decrease a band gap of the barrier layer.

1 29. The method of claim 17, wherein annealing the active region to enhance
2 migration of the diffusion components from the first magnetic layer to the barrier layer
3 comprises forming AlHfO_x in the barrier layer.

1 30. The method of claim 17, wherein annealing the active region to enhance
2 migration of the diffusion components from the first magnetic layer to the barrier layer
3 comprises forming AlZrO_x in the barrier layer.

1 31. A method for sensing a magnetic field, comprising:
2 forming a magnetic tunnel junction device having an active region, comprising:
3 a first magnetic layer and a second magnetic layer, at least one of the first
4 and the second magnetic layers including diffusion components selected to adjust
5 one or more properties of the magnetic tunnel junction device; and
6 a barrier layer between the first and the second magnetic layers; and
7 annealing the active region to enhance migration of the diffusion components
8 from the first magnetic layer to the barrier layer, the migrated diffusion components
9 adjusting the one or more properties;
10 driving the magnetic tunnel junction device using an electrical signal; and
11 detecting an electrical resistance based on magnetic orientations of the first and
12 the second magnetic layers.

1 32. The method of claim 31, wherein the at least one layer comprises CoFeHf .

1 33. The method of claim 31, wherein the at least one layer comprises CoFeZr .

1 34. The method of claim 31, wherein the diffusion components comprise Hf .

1 35. The method of claim 31, wherein the diffusion components comprise Zr .

1 36. The method of claim 31, wherein annealing the active region comprises
2 annealing the active region at a temperature of about 300 C.

1 37. The method of claim 31, wherein the diffusion components are selected to
2 reduce a series resistance of the active region.

1 38. The method of claim 31, wherein the diffusion components are selected to
2 decrease a bandgap of the barrier layer.

1 39. The method of claim 31, wherein annealing the active region to enhance
2 migration of the diffusion components from the first magnetic layer to the barrier layer
3 comprises forming AlHfO_x in the barrier layer.

 40. The method of claim 31, wherein annealing the active region to enhance
5 migration of the diffusion components from the first magnetic layer to the barrier layer
 comprises forming AlZrO_x in the barrier layer.